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MOUNTAIN ISLAND, LAKE GASTON AND MECKLENBURG COUNTIES, NORTH CAROLINA

Pacific Northwest Environmental Research Laboratory

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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REPORT
ON
MOUNTAIN ISLAND LAKE
GASTON AND MECKLENBURG COUNTIES
NORTH CAROLINA
EPA REGION IV
WORKING PAPER No. 386

WITH THE COOPERATION OF THE

NORTH CAROLINA DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES

AND THE

NORTH CAROLINA NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the North Carolina Department of Natural and Economic Resources for professional involvement and to the North Carolina National Guard for conducting the tributary sampling phase of the Survey.

Lewis R. Martin, Director of the Division of Environmental Management; Darwin L. Coburn, Chief of the Water Quality Section; and Julian R. Taylor, Supervisor of the Monitoring Program Unit; provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

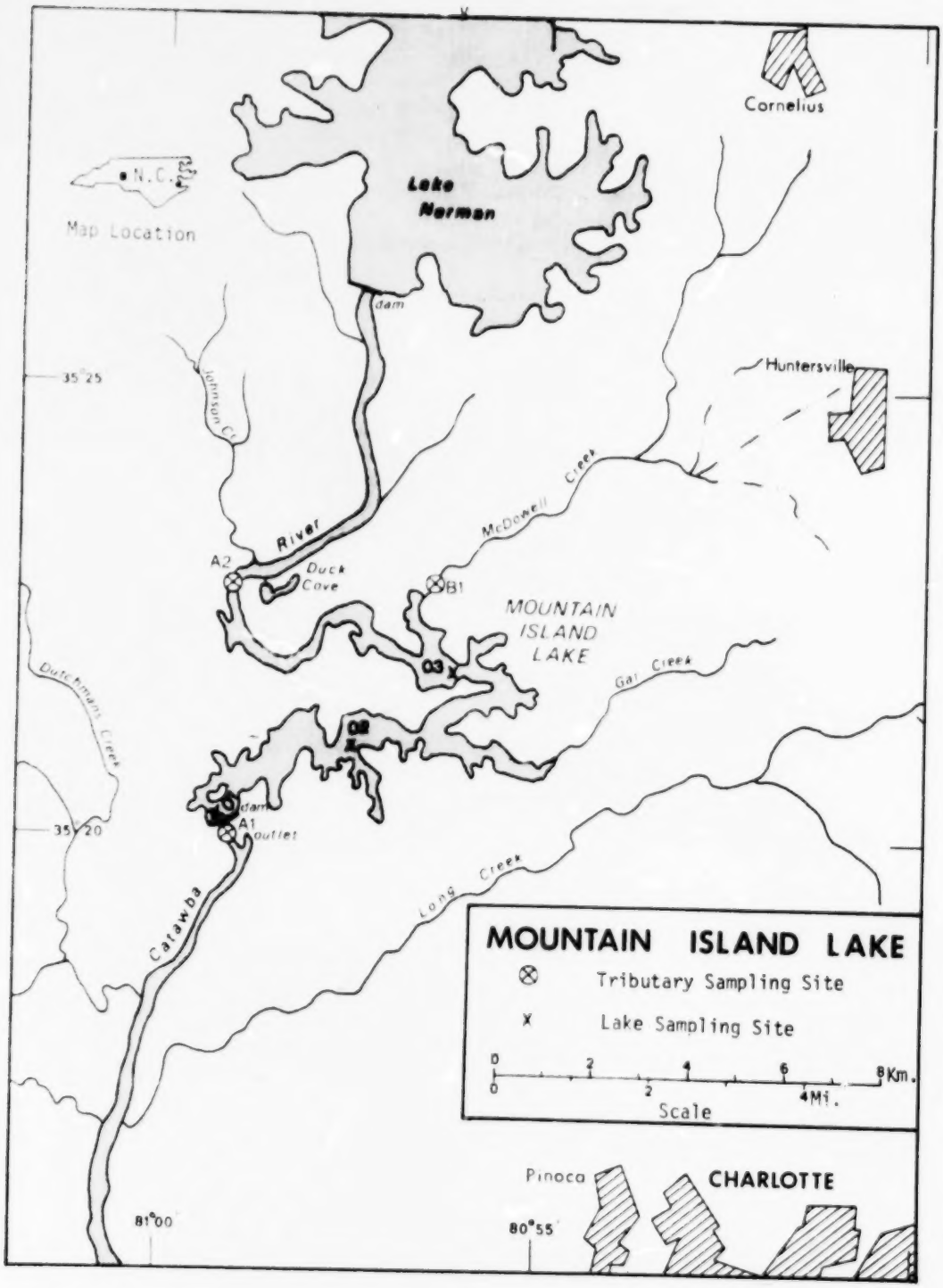
Major General William M. Buck, formerly Adjutant General of North Carolina, and Project Officer Colonel Arthur J. Bouchard, who directed the volunteer efforts of the North Carolina National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NORTH CAROLINA

LAKE NAME	COUNTY
Badin	Montgomery, Stanly
Blewett Falls	Anson, Richmond
Chatuge	Clay, NC; Towns, GA
Fontana	Graham, Swain
Hickory	Alexander, Caldwell, Catawba
High Rock	Davidson, Rowan
Hiwassee	Cherokee
James	Burke, McDowell
John H. Kerr (Nut Bush Creek)	Granville, Vance, Warren, NC; Halifax, Mecklenburg, VA
Junaluska	Haywood
Lookout Shoals	Alexander, Catawba, Iredell
Mountain Island	Gaston, Mecklenburg
Norman	Catawba, Iredell, Lincoln, Mecklenburg
Rhodhiss	Burke, Caldwell
Santeetlah	Graham
Tillery	Montgomery, Stanly
Waccamaw	Columbus
Waterville	Haywood
Wylie	Gaston, Mecklenburg, NC; York, SC


Cornelius
N.C.
Map Location
Lake Norman
dam
Huntersville
35°25
Johnson Cr.
McDowell Creek
River
A2
Duck Cove
B1
MOUNTAIN ISLAND LAKE
03
Gar Creek
Dutchmans Creek
02
dam
A1
outlet
35°20
Catawba
Long Creek
MOUNTAIN ISLAND LAKE
Tributary Sampling Site
Lake Sampling Site
0 2 4 6 8 Km.
0 2 4 Mi.
Scale
Pinoca
CHARLOTTE
81°00
80°55

MOUNTAIN ISLAND LAKE

STORET NO. 3711

I. CONCLUSIONS

A. Trophic Condition:

Survey data show that Mountain Island Lake is mesotrophic. However, because this water body has a mean hydraulic retention time of only 12 days, it more closely resembles a slow-moving river; and the term "moderately-enriched" may be a more appropriate description of the condition of the lake.

Mountain Island Lake ranked third in overall trophic quality when the 16 North Carolina lakes sampled in 1973 were compared using a combination of six parameters*. Three of the lakes had less and one had the same median total phosphorus, one had less and one had the same median dissolved phosphorus, four had less median inorganic nitrogen, seven had less mean chlorophyll a, and eight had greater and one had the same mean Secchi disc transparency.

Survey limnologists reported sparse emergent vegetation along much of the shoreline but no concentrations of algae.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Mountain Island Lake was phosphorus limited at the time the assay sample was collected (04/02/73). These results are substantiated by the

* See Appendix A.

lake data during April and July; i.e., the mean N/P ratios were 39/1 or greater at all sampling stations. During September, the lake probably was nitrogen limited; the mean N/P ratios were 13/1 or less at all stations, and nitrogen limitation would be expected.

C. Nutrient Controllability:

1. Point sources--There were no known point sources directly impacting Mountain Island Lake during the sampling year. However, point sources upstream in the Catawba River drainage contribute phosphorus indirectly (e.g., 9% of the total phosphorus load to Lake Norman* was contributed by point sources). Any reduction of the upstream point-source phosphorus inputs would be expected to benefit Mountain Island Lake since the lake is phosphorus limited much of the time.

The present Mountain Island Lake phosphorus loading rate of 4.31 $g/m^2/yr$ is 1.8 times the rate proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic rate (see page 13). However, the mean hydraulic retention time of the lake is a short 12 days, and Vollenweider's model probably does not apply.

2. Non-point sources--The phosphorus contribution of the Catawba River accounted for nearly 87% of the total reaching

* Working Paper No. 387.

Mountain Island Lake. McDowell Creek contributed 11% of the total, and the unsampled minor tributaries were estimated to have contributed 1.4% of the total load.

The phosphorus export rate of McDowell Creek was a very high 91 kg/km^2 during the sampling year (see page 12). Since no point sources are known to impact the creek, the high rate may be due to urban drainage from Huntersville.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 13.09 kilometers^2.
2. Mean depth: 5.4 meters.
3. Maximum depth: 17.8 meters.
4. Volume: 70.7 x 10^6 m^3.
5. Mean hydraulic retention time: 12 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area km^2)*	Mean flow (m^3/sec)*
Catawba River	4,693.1	65.4
McDowell Creek	69.9	1.0
Minor tributaries & immediate drainage -	46.5	0.8
Totals	4,809.5	67.2

2. Outlet -

Catawba River	4,822.6**	67.2**

C. Precipitation***:

1. Year of sampling: 124.6 centimeters.
2. Mean annual: 112.9 centimeters.

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† Table of metric conversions--Appendix B.
†† Park, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake; outflow adjusted to equal inflow.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Mountain Island Lake was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (two samples were taken at station 1 in July; see map, page v). During each visit, a single depth-integrated (4.6 m to surface) sample was composited from the three stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll *a* analysis. The maximum depths sampled were 16.8 meters at station 1, 9.1 meters at station 2, and 4.9 meters at station 3.

The lake sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR MOUNTAIN ISLAND LAKE
STORET CODE 3711

PARAMETER	1ST SAMPLING (4/ 2/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 7/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/19/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	13.7 - 14.6	13.1	13.8	24.6 - 29.3	26.6	26.4	25.6 - 28.0	26.8	26.8
DISS OXY (MG/L)	9.4 - 10.2	9.8	9.8	4.3 - 7.3	5.9	5.8	2.2 - 7.4	5.9	6.8
CNDCTVY (MCHO)MO)	55. - 70.	64.	60.	40. - 60.	51.	54.	59. - 65.	62.	62.
PH (STAND UNITS)	6.8 - 7.3	7.1	7.0	6.4 - 7.4	6.6	6.6	6.3 - 6.9	6.6	6.6
TOT ALK (MG/L)	10. - 13.	11.	11.	13. - 20.	17.	17.	12. - 18.	15.	15.
TOT P (MG/L)	0.025 - 0.068	0.043	0.032	0.012 - 0.027	0.017	0.016	0.009 - 0.020	0.013	0.013
ORTHO P (MG/L)	0.004 - 0.011	0.007	0.006	0.002 - 0.006	0.003	0.003	0.004 - 0.013	0.008	0.007
NO2+NO3 (MG/L)	0.140 - 0.320	0.237	0.285	0.140 - 0.190	0.168	0.173	0.020 - 0.060	0.035	0.030
AMMONIA (MG/L)	0.040 - 0.100	0.074	0.070	0.070 - 0.170	0.112	0.100	0.020 - 0.160	0.047	0.030
KJEL N (MG/L)	0.200 - 0.400	0.238	0.250	0.200 - 0.600	0.341	0.400	0.200 - 0.600	0.364	0.300
INORG N (MG/L)	0.230 - 0.400	0.332	0.375	0.210 - 0.360	0.280	0.280	0.050 - 0.220	0.083	0.050
TOTAL N (MG/L)	0.350 - 0.690	0.515	0.505	0.360 - 0.750	0.509	0.540	0.230 - 0.640	0.399	0.330
CHLRPYL A (UG/L)	3.2 - 6.0	5.1	5.5	4.1 - 5.7	4.7	4.6	5.9 - 8.3	7.2	7.3
SECCHI (METERS)	0.4 - 0.7	0.6	0.6	0.9 - 1.5	1.2	1.1	0.9 - 1.4	1.1	0.9

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal units per ml
04/02/73	1. Melosira	1,178
	2. Flagellates	626
	3. Asterionella	61
	4. Dactylococcopsis	25
	5. Oscillatoria	12
	Other genera	25
	Total	1,927
07/10/73 (station 01)	1. Melosira	1,008
	2. Flagellates	344
	3. Pennate diatoms	295
	4. Peridinium	221
	5. Cosmarium	197
	Other genera	395
	Total	2,460
07/12/73 (stations 01 & 02)	1. Melosira	335
	2. Flagellates	112
	3. Peridinium	56
	4. Synedra	56
	5. Tetraedon	37
	Other genera	73
	Total	669
09/19/73	1. Lyngbya	525
	2. Melosira	358
	3. Raphidiopsis	267
	4. Chlorella	235
	5. Cryptomonas	201
	Other genera	785
	Total	2,371

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/02/73	01	6.6
	02	5.5
	03	3.2
07/07, 10, 12/73	01	4.1-5.7
	02	4.2
	03	5.0
09/19/73	01	5.9
	02	8.3
	03	7.3

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.020	0.312	0.2
0.050	0.070	0.312	15.6
0.050 + 1.0 N	0.070	1.312	16.9
1.0 N	0.020	1.312	0.3

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Mountain Island Lake was moderate at the time the sample was collected. The addition of orthophosphorus alone produced a 78-fold increase in yield over that of the control which indicates phosphorus limitation. Note that addition of

nitrogen alone resulted in a yield not significantly greater than the control yield.

The lake data indicate phosphorus limitation in April and July; i.e., the mean inorganic nitrogen to orthophosphorus ratios were 39 to 1 or greater at all stations. The September data indicate probable nitrogen limitation; the mean inorganic nitrogen to orthophosphorus ratios were 13 to 1 or less at all stations, and nitrogen limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the North Carolina National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of January and February when two samples were collected. Sampling was begun in March, 1973, and was completed in March, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the North Carolina District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using means of the nutrient loads, in $kg/km^2/year$, at stations B-1 and D-1 of nearby Lake Norman and multiplying the means by the ZZ area in km^2.

* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Catawba River	49,010	86.9
McDowell Creek	6,390	11.3
b. Minor tributaries & immediate drainage (non-point load) -	765	1.4
c. Known municipal STP's - None	-	-
d. Septic tanks - Unknown	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	230	0.4
Total	56,395	100.0

2. Outputs -

Lake outlet - Catawba River 42,815

3. Net annual P accumulation - 13,580 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Catawba River	1,599,080	94.9
McDowell Creek	48,085	2.9
b. Minor tributaries & immediate drainage (non-point load) -	23,880	1.4
c. Known municipal STP's - None	-	-
d. Septic tanks - Unknown	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	14,130	0.8
Total	1,685,175	100.0

2. Outputs -

Lake outlet - Catawba River 1,810,470

3. Net annual N loss - 125,295 kg.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Catawba River	10	341
McDowell Creek	91	688

* See Working Paper No. 175.

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	4.31	1.04	128.7	loss*

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Mountain Island Lake:

"Dangerous" (eutrophic rate)	2.40
"Permissible" (oligotrophic rate)	1.20

* There was an apparent loss of nitrogen during the sampling year. This may have been due to nitrogen fixation in the lake, solubilization of previously sedimented nitrogen, recharge with nitrogen-rich ground water, unknown and unsampled point sources discharging directly to the lake, or insufficient outlet sampling in relation to the very short hydraulic retention time of the lake. Whatever the cause, a similar nitrogen loss has occurred at Shagawa Lake, Minnesota, which has been intensively studied by EPA's National Eutrophication and Lake Restoration Branch (Malueg et al., 1975).

V. LITERATURE REVIEWED

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VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3719	LAKE WACCAMAW	534
2	3716	SANTEELAH LAKE	446
3	3711	MOUNTAIN ISLAND LAKE	419
4	3707	HIWASSEE LAKE	414
5	3704	FONTANA LAKE	392
6	3713	LAKE NORMAN	346
7	3708	LAKE JAMES	334
8	3710	LOOKOUT SHOALS	327
9	3715	RHODHISS LAKE	296
10	3705	LAKE HICKORY	283
11	3717	LAKE TILLERY	248
12	3709	LAKE JUNALUSKA	220
13	3702	BLEWETT FALLS LAKE	200
14	3718	WATERVILLE RESERVOIR	140
15	3701	BADIN LAKE	124
16	3706	HIGH ROCK LAKE	76

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3701	BADIN LAKE	0.042	0.680	466.750	7.190	14.900	0.012
3702	BLEWETT FALLS LAKE	0.090	0.655	476.889	4.167	10.800	0.034
3704	FONTANA LAKE	0.011	0.550	392.650	3.438	14.900	0.007
3705	LAKE HICKORY	0.047	0.320	461.000	7.275	13.400	0.008
3706	HIGH ROCK LAKE	0.090	0.580	477.454	14.283	14.800	0.017
3707	HIWASSEE LAKE	0.015	0.240	420.555	5.678	14.200	0.007
3708	LAKE JAMES	0.020	0.160	428.866	7.660	14.800	0.006
3709	LAKE JUNALUSKA	0.031	0.560	462.000	7.233	14.200	0.009
3710	LOOKOUT SHOALS	0.026	0.370	459.167	4.200	13.800	0.008
3711	MOUNTAIN ISLAND LAKE	0.018	0.270	462.000	5.580	12.800	0.005
3713	LAKE NORMAN	0.019	0.330	446.667	5.807	14.800	0.005
3715	RHODHISS LAKE	0.061	0.305	462.111	3.578	13.600	0.019
3716	SANTEELAH LAKE	0.011	0.160	366.400	5.360	14.800	0.006
3717	LAKE TILLERY	0.040	0.470	468.600	6.827	13.600	0.008
3718	WATERVILLE RESERVOIR	0.103	0.860	468.333	3.817	14.400	0.041
3719	LAKE WACCAMAW	0.018	0.120	455.667	3.583	9.800	0.004

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	1S- MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3701	BADIN LAKE	33 (5)	7 (1)	27 (4)	27 (4)	3 (0)	27 (4)	124
3702	BLEWETT FALLS LAKE	7 (1)	13 (2)	7 (1)	73 (11)	93 (14)	7 (1)	200
3704	FONTANA LAKE	100 (15)	33 (5)	93 (14)	100 (15)	3 (0)	63 (9)	392
3705	LAKE HICKORY	27 (4)	60 (9)	53 (8)	13 (2)	80 (12)	50 (7)	283
3706	HIGH ROCK LAKE	13 (2)	20 (3)	0 (0)	0 (0)	23 (2)	20 (3)	76
3707	HIWASSEE LAKE	87 (13)	80 (12)	87 (13)	47 (7)	50 (7)	63 (9)	414
3708	LAKE JAMES	60 (9)	87 (13)	80 (12)	7 (1)	23 (2)	77 (11)	334
3709	LAKE JUNALUSKA	47 (7)	27 (4)	43 (6)	20 (3)	50 (7)	33 (5)	220
3710	LOOKOUT SHOALS	53 (8)	47 (7)	60 (9)	67 (10)	60 (9)	40 (6)	327
3711	MOUNTAIN ISLAND LAKE	73 (11)	73 (11)	43 (6)	53 (8)	87 (13)	90 (13)	419
3713	LAKE NORMAN	67 (10)	53 (8)	73 (11)	40 (6)	23 (2)	90 (13)	346
3715	RHODHISS LAKE	20 (3)	67 (10)	33 (5)	93 (14)	70 (10)	13 (2)	296
3716	SANTEELAH LAKE	93 (14)	93 (14)	100 (15)	60 (9)	23 (2)	77 (11)	446
3717	LAKE TILLERY	40 (6)	40 (6)	13 (2)	33 (5)	70 (10)	50 (7)	246
3718	WATERVILLE RESERVOIR	0 (0)	0 (0)	20 (3)	80 (12)	40 (6)	0 (0)	140
3719	LAKE WACCAMAW	80 (12)	100 (15)	67 (10)	87 (13)	100 (15)	100 (15)	534

APPENDIX B

CONVERSIONS FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NORTH CAROLINA 10/21/75

LAKE CODE 3711 MOUNTAIN ISLAND RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ MI) 1862.00

TRIBUTARY	SUB-DRAINAGE AREA(SQ MI)	NORMALIZED FLOWS(CFS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3711A1	1862.00	3000.00	2180.00	1990.00	1870.00	2060.00	2330.00	2160.00	2070.00	2480.00	2490.00	2830.00	2300.00	2313.73
3711A2	1812.00	2920.00	2110.00	1920.00	1870.00	2170.00	2470.00	2140.00	2120.00	2470.00	2510.00	2790.00	2210.00	2308.96
3711B1	27.00	42.00	55.00	62.00	50.00	29.00	30.00	24.00	22.00	21.00	26.00	23.00	36.00	34.88
3711Z2	23.00	36.00	47.00	52.00	43.00	25.00	26.00	21.00	19.00	16.00	22.00	20.00	31.00	29.90

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 1862.00
SUM OF SUB-DRAINAGE AREAS = 1862.00

TOTAL FLOW IN = 28480.00
TOTAL FLOW OUT = 27760.00

MEAN MONTHLY FLOWS AND DAILY FLOWS(CFS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3711A1	3	73	6610.00	24	6300.00				
	4	73	6550.00	29	9670.00				
	5	73	5260.00						
	6	73	4300.00	3	4170.00				
	7	73	3760.00	1	686.00				
	8	73	3730.00	4	128.00				
	9	73	3360.00	9	144.00				
	10	73	1940.00	14	128.00				
	11	73	2360.00	4	128.00				
	12	73	2780.00	8	2670.00				
	1	74	3780.00	6	1360.00	21	825.00		
	2	74	3990.00	3	2780.00	15	6270.00		
	3	74	3740.00	3	165.00				
3711A2	3	73	6330.00	24	5400.00				
	4	73	6410.00	29	8640.00				
	5	73	5290.00						
	6	73	4290.00	3	4400.00				
	7	73	3650.00	1	740.00				
	8	73	3700.00	4	130.00				
	9	73	3350.00	9	130.00				
	10	73	1730.00	14	130.00				
	11	73	2200.00	4	130.00				
	12	73	2580.00	8	3680.00				
	1	74	3530.00	6	1680.00	21	130.00		
	2	74	3990.00	3	2420.00	15	6320.00		
	3	74	3710.00	3	350.00				

TRIBUTARY FLOW INFORMATION FOR NORTH CAROLINA 10/21/75

LAKE CODE 3711 MOUNTAIN ISLAND RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CFS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
371181	3	73	100.00	24	54.00				
	4	73	75.00	29	44.00				
	5	73	65.00						
	6	73	35.00	3	34.00				
	7	73	20.00	1	23.00				
	8	73	18.00	4	41.00				
	9	73	19.00	9	15.00				
	10	73	19.00	14	16.00				
	11	73	18.00	4	25.00				
	12	73	36.00	8	28.00				
	1	74	75.00	6	50.00	21	470.00		
	2	74	55.00	3	115.00	15	38.00		
	3	74	48.00	3	34.00				
371122	3	73	90.00						
	4	73	65.00						
	5	73	55.00						
	6	73	30.00						
	7	73	17.00						
	8	73	15.00						
	9	73	16.00						
	10	73	16.00						
	11	73	15.00						
	12	73	31.00						
	1	74	68.00						
	2	74	45.00						
	3	74	40.00						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/10/20

371101
35 20 12.0 080 59 10.0
MOUNTAIN ISLAND LAKE
37071 NORTH CAROLINA

11EMALES
3

2111202
0059 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	
73/04/02	08 15	0000	14.6		27	60	7.20	12	0.070	0.200	0.280	0.006	
	08 15	0004	14.5	10.2		55	7.30	13	0.060	0.200K	0.280	0.006	
	08 15	0015	13.5	9.8		60	7.00	10K	0.060	0.300	0.140	0.005	
	08 15	0035	13.0	10.1		60	7.00	10K	0.060	0.200	0.150	0.005	33
	08 15	0055	12.4	9.8		60	7.00	10K	0.060	0.300	0.150	0.004	34
73/07/07	16 30	0000	29.0		60	60	7.40	13	0.080	0.600	0.150	0.006	
	16 30	0010	28.5	7.3		55	6.80	13	0.070	0.400	0.140	0.003	
	16 30	0030	26.4	5.7		55	6.60	13	0.090	0.400	0.150	0.003	
	16 30	0051	25.3	4.3		59	6.60	15	0.140	0.500	0.160	0.004	
73/07/10	16 30	0000	29.3		48	60	6.70	16	0.130	0.300	0.170	0.005	
	16 30	0005	27.3	6.3		57	6.60	17	0.130	0.200K	0.160	0.003	
	16 30	0015	26.4	6.1		54	6.50	20	0.120	0.400	0.180	0.005	
	16 30	0028	26.1	5.8		54	6.50	18	0.150	0.400	0.170	0.003	
	16 30	0040	25.7	5.4		54	6.60	20	0.140	0.500	0.170	0.002	
	16 30	0053	25.3	5.3		55	6.40	19	0.170	0.500	0.190	0.003	
73/09/19	15 55	0000	28.0	5.2	57	62	6.70	15	0.040	0.500	0.040	0.012	
	15 55	0015	27.4			63	6.60	13	0.030	0.200	0.030	0.007	
	15 55	0030	26.4			63	6.50	14	0.040	0.200K	0.040	0.007	
	15 55	0040	26.4	3.6		62	6.30	16	0.070	0.200	0.040	0.004	
	15 55	0053	26.1	2.2		65	6.40	18	0.160	0.400	0.060	0.011	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 73/10/29

371101
35 20 12.0 082 34 10.0
MOUNTAIN ISLAND LAKE
37071 NORTH CAROLINA

TIEPALES 2111202
3 0054 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/02	08 15	0000	0.031	6.6
	08 15	0004	0.029	
	08 15	0015	0.032	
	08 15	0035	0.026	
	08 15	0055	0.052	
73/07/07	16 30	0000	0.023	4.1
	16 30	0010	0.013	
	16 30	0030	0.017	
	16 30	0051	0.018	
73/07/10	16 30	0000	0.021	5.7
	16 30	0006	0.012	
	16 30	0015	0.012	
	16 30	0028	0.020	
	16 30	0040	0.015	
	16 30	0053	0.018	
73/09/19	15 55	0000	0.014	5.9
	15 55	0015	0.009	
	15 55	0030	0.009	
	15 55	0040	0.013	
	15 55	0053	0.014	

STORET RETRIEVAL DATE 73/10/20

371102
35 20 57.0 080 57 33.0
MOUNTAIN ISLAND LAKE
37119 NORTH CAROLINA

11EPALES
3

2111202
0034 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/02	08	50 0000	14.2		14	70	7.00	11	0.100	0.300	0.280	0.010
	08	50 0004	14.2	9.6		61	6.80	12	0.090	0.400	0.290	0.011
	08	50 0015	14.1	9.4		60	6.90	12	0.100	0.300	0.300	0.010
	08	50 0030	14.1	9.6		60	7.00	11	0.090	0.300	0.290	0.009
73/07/12	12	50 0000	27.4		40	43	6.70	14	0.110	0.400	0.150	0.003
	12	50 0006	26.4	7.2		40	6.80	18	0.100	0.200	0.180	0.003
	12	50 0015	26.0	5.4		42	6.50	16	0.100	0.200K	0.180	0.002
	12	50 0024	25.6	5.1		40	6.50	16	0.090	0.200	0.160	0.003
73/09/19	15	30 0000	27.5	7.4	37	60	6.90	13	0.030	0.600	0.030	0.013
	15	30 0012	27.2	7.2		63	6.60	13	0.030	0.300	0.030	0.007
	15	30 0024	26.8	6.8		64	6.50	12	0.030	0.300	0.020	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	03565 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/02	08	50 0000	0.008	3.5
	08	50 0004	0.006	
	08	50 0015	0.002	
	08	50 0030	0.004	
73/07/12	12	50 0000	0.021	4.2
	12	50 0006	0.014	
	12	50 0015	0.015	
	12	50 0024	0.014	
73/09/19	15	30 0000	0.020	4.3
	15	30 0012	0.009	
	15	30 0024	0.011	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 73/10/20

371103
35 21 47.0 080 56 12.0
MOUNTAIN ISLAND LAKE
37119 NORTH CAROLINA

11EPALES
3

2111202
0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/02	09 30	0000	10.8		24	60	7.10	12	0.070	0.200K	0.320	0.008
	09 30	0004	11.0	9.6		60	7.10	11	0.070	0.200K	0.300	0.006
	09 30	0015	10.7	9.8		60	7.30	11	0.060	0.200K	0.310	0.005
73/07/12	13 20	0000	26.4		37	45	6.50	17	0.090	0.200	0.170	0.003
	13 20	0006	25.6	6.4		43	6.60	19	0.090	0.200K	0.190	0.003
	13 20	0016	24.6	5.7		44	6.50	20	0.100	0.200K	0.190	0.003
73/09/19	14 40	0000	26.7	7.0	36	62	6.70	16	0.040	0.600	0.040	0.007
	14 40	0008	26.0	7.0		59	6.60	16	0.030	0.400	0.030	0.007
	14 40	0015	25.6	6.8		60	6.60	16	0.020K	0.300	0.030	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/02	09 30	0000	0.032	3.2
	09 30	0004	0.029	
	09 30	0015	0.031	
73/07/12	13 20	0000	0.014	5.0
	13 20	0006	0.016	
	13 20	0016	0.016	
73/09/19	14 40	0000	0.013	7.3
	14 40	0008	0.013	
	14 40	0015	0.014	

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 75/10/20

3711A1 LS3711A1
35 20 00.0 080 54 00.0
CATAWBA RIVER
37035 7.5 PAW CREEK
CAT ISLAND RESVR
FROM DAM 0.6 MI E OF MOUNTAIN ISLAND
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/24	10	05	0.253	0.340	0.040	0.005K	0.020
73/04/29	07	40	0.240	0.350	0.016	0.006	0.022
73/06/03	09	00	0.180	0.290	0.054	0.012	0.015
73/07/01	08	10	0.132	0.550	0.063	0.005K	0.010
73/08/04	10	05	0.088	3.200	0.154	0.005K	0.020
73/09/09	09	50	0.030	0.220	0.019	0.005K	0.015
73/10/14	10	35	0.060	0.600	0.096	0.006	0.010
73/11/04	10	05	0.080	0.450	0.088	0.010	0.010
73/12/04	10	10	0.104	0.200	0.044	0.005K	0.060
74/01/08	09	50	0.252	0.300	0.020	0.008	0.030
74/01/21	14	20	0.264	0.500	0.032	0.005K	0.015
74/02/03	11	30	0.264	1.400	0.070	0.065	
74/02/15	13	40	0.240	0.200	0.020	0.005K	0.025
74/03/03	09	20	0.252	0.500	0.025	0.005K	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/20

3/11A2 E53/11A2
35 23 00.0 080 59 30.0
CATAWBA RIVER
37 7.5 MICKS CROSSI
IZMT ISLAND RESVR
END DIRT RD 1.5 MI S OF LINCOLN CO LINE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/24	10	40	0.260	0.400	0.115	0.005K	0.035
73/04/24	08	05	0.230	0.340	0.055	0.006	0.020
73/06/03	09	30	0.170	0.160	0.018	0.005K	0.010
73/07/01	08	55	0.134	0.440	0.028	0.005K	0.010
73/08/04	10	35	0.065	1.600	0.115	0.005K	0.015
73/09/09	10	10	0.030	0.220	0.016	0.007	0.010
73/10/14	10	15	0.060	0.250	0.038	0.005K	0.005K
73/11/04	10	25	0.063	0.550	0.068	0.007	0.015
73/12/04	10	35	0.112	0.300	0.068	0.005K	0.010
74/01/06	10	05	0.252	0.600	0.032	0.005K	0.015
74/01/21	14	45	0.216	0.300	0.032	0.012	0.055
74/02/03	09	40	0.240	1.600	0.105	0.020	0.070
74/02/15	14	05	0.252	1.000	0.055	0.005K	0.045
74/03/03	10	15	0.252	0.500	0.045	0.005K	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/20

3/1181 LS3/1181
35 22 30.0 080 56 30.0
MCDOWELL CREEK
37 1.5 HICKS CROSSI
T/MT ISLAND RESVR
BRDG ON UNAMED RD 1.2 # BEATTY FORD RD
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/24	11 15		0.378	0.420	0.070	0.034	0.095
73/04/24	08 30		0.399	0.500	0.110	0.058	0.105
73/06/03	10 00		0.630	0.360	0.056	0.092	0.175
73/07/01	09 25		0.540	0.270	0.032	0.132	0.180
73/08/04	10 05		0.420	3.100	0.160	0.044	0.350
73/09/09	10 45		0.725	1.800	0.420	0.176	0.260
73/10/14	11 30		0.670	0.900	0.069	0.168	0.270
73/11/04	10 55		0.503	0.800	0.040	0.200	0.270
73/12/08	11 05		0.616	0.800	0.098	0.132	0.185
74/01/06	10 30		0.504	0.500	0.032	0.060	0.145
74/01/21	15 30		0.384	1.150	0.232	0.064	0.313
74/02/03	09 30		0.264	0.606	0.045		
74/02/15	14 30		0.440	1.100	0.105	0.045	0.125
74/03/03	11 45		0.440	2.150	0.080	0.085	0.148